Distributed learning and prediction modelling in radiation oncology

Appendix II

Valorization

For distributed data infrastructures and machine learning algorithms to last in radiotherapy, they need to add value to society and/or be capitalized in the private sector.
Distributed data infrastructures may form integral parts of future radiotherapy clinics for the benefit of society and each individual patient. Therefore, (inter)national governments may decide to mandate it for healthcare providers.
It is in the interest of the public to

- foster access to patient data for medical research,
- control the quality of care by healthcare providers,
- ensure patient privacy and control over the data.

Distributed data infrastructures support these three aspects. It is possible to apply machine learning algorithms or other kinds of data analysis processes via the infrastructure. Similarly, it is possible to compare treatments across clinics using statistical analyses. Most importantly, the data always remains at the institute where the data was generated (i.e. where the patient was treated) and the external analyst does not have direct access to the data. Standardization of medical data on an (inter)national level may pose the biggest challenge which is, however, inevitable regardless whether centralized or distributed data infrastructures are used. Therefore, it will be in the interest of public health to support or even prescribe participation in distributed data infrastructures for radiotherapy clinics.

Distributed data infrastructures also have commercial applications: medical research companies require access to patient data for pharmaceutical, device, or software development. A distributed data infrastructure would provide patients a platform to sell restricted access to their data while maintaining control and ensuring anonymity.
The Varian Learning Portal[1] (chapters 2 & 3) is evidence that the private sector sees promise in distributed data infrastructures for radiotherapy: it is free to use for radiotherapy clinics to learn prediction models using data from participating institutes but Varian has the first right of refusal for commercialization of the resulting models.

Machine learning algorithms for radiotherapy (and other medical applications) have applications with substantial benefit to society and clear commercialization prospects.
Machine learning models have the potential to assist medical professionals in repetitive tasks and complex decision-making processes:

- organ/tumor delineation[2],
- treatment planning quality control[3],
- decision support systems for treatment selection[4].

Most notably, the guidelines to select patients for proton therapy in the Netherlands prescribes a model-based decision process in which patient cases with certain diagnoses will be evaluated using (machine learning) models[5].
Reducing the time spent on these tasks saves resources and thus decreases public healthcare spending. Assisting medical professionals in making better decisions improves healthcare outcomes. Therefore, society will benefit if properly tested machine learning models become part of the radiotherapy process.

The development of machine learning models for medical applications is a long and expensive process in a heavily regulated industry but with a large global market. Individual hospitals, whose only focus is to treat their patients, will hesitate to pursue this enterprise given the high costs but private investors and multinational companies have the means and interest to finance the development at the prospect of high future payoffs. IBM Watson for Oncology[6] is an example for a large multinational corporation to develop decision support systems for oncology but investors also finance small businesses: two examples originating from Maastricht University/MAASTRO clinic are ptTheragnostic B.V.[7], which is working on decision support for proton radiotherapy, and Oncoradiomics SA[8], which is working on image-based biomarkers for radiotherapy.

In conclusion, distributed data infrastructures and machine learning algorithms for radiotherapy have clear valorization prospects both for the benefit of society and commercialization.

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